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Seminar

Total Variation in Tomography

Professor Per Christian Hansen
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Abstract: Tomography problems arise in numerous areas, such as medical imaging, nondestructive testing, and geophysics. These problems amount to reconstructing an object from its projections along a number of directions, and these projections are produced by X-rays, seismic waves, or other “rays” penetrating the object in such a way that their intensity is partially absorbed by the object. The absorption thus gives information about the object.

Classical reconstruction methods are often based on the 2-norm, which leads to fast algorithms – but unfortunately the reconstructions often lack sharp edges and contrast. Total variation is a powerful alternative reconstruction technique when the sought solution is required to have sharp edges – but unfortunately it leads to large and challenging computational problems.

We present a practical implementation of an optimal first-order method for strongly convex functions, due to Nesterov, tailored to large-scale total variation regularization. Nesterov’s algorithm requires knowledge of both the Lipschitz constant and the strong convexity parameter, both of which are usually unknown, and our implementation incorporates mechanisms to estimate these important parameters during the iterations – thus making the algorithm suited for practical use. We discuss the convergence rate and the iteration complexity for our algorithm, and we use a 3D medical tomography problem to compare our algorithm with other first-order methods.

Date: 21 October 2010 (Thursday)
Venue: C1, Lady Shaw Building,
The Chinese University of Hong Kong, Shatin
Time: 3:30 p.m. – 4:30 p.m.

All are Welcome!